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California Energy Commission
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Re: Docket # 15-BSTD-01

POSSIBLE EQUIPMENT DAMAGE AND LIABILITY CREATED BY CODE LANGUAGE IN Section 130.4 (a) AND SECTION 140.6 (a) 2. J. AND IN THE NONRESIDENTIAL APPENDICES TO PART 6: SECTION NA7.7.6 Lighting Controls Installed to Earn a Power Adjustment Factor (PAF); NA7.7.6.2 Acceptance Tests for Institutional Tuning

***INTRODUCTION*:**

The 15-Day Language 2016 Building Energy Efficiency Standards Section 140.6 allows the use of Power Adjustment Factors to compute Control Credits during the lighting design process. Section 130.4 (b), (in accordance with Section 10-103 (a)), mandates the submission of Installation Certificates for Part 6 compliance of claimed Power Adjustment Factors. Section 10-103 (a) 3. requires that a Certificate of Installation, (NRCI-LTI-05-E for Power Adjustment Factors), be signed by "… the person in charge of construction or installation …". Specifications for Installation Inspections are found in Section NA7.7 of the Reference Appendices.

A concern is that the intent of a new Power Adjustment Factor under NA7.7.6.2 is to require Acceptance Testing for a scheme referred to as: Institutional Tuning.

ABSTRACT:

Verifying Institutional Tuning by an Acceptance Test Technician requires documentation and information not legally required to be presented to them. Institutional Tuning does not *necessarily* lead to energy savings as it is a Power Adjustment Factor, (Note: the author of this document is *not* a lighting designer, but *believes* that Control Credit wattage can be "traded off" to other areas under some circumstances). If this is true: the Institutional Tuning Control Credits can be assumed to be used elsewhere in the lighting design. Institutional Tuning verification may force Field Technicians to deprogram lighting controls or open 0-10V or digital control lines. Institutional Tuning Acceptance Testing can cause lengthy delays at a site undergoing testing, causing an undue financial burden on building owners and electrical contractors. Institutional Tuning Acceptance Testing assumes a level of knowledge and expertise of a Field Technician that is not readily imparted during Lighting Controls Acceptance Test Technician training.

THE ARGUMENT AGAINST INSTITUTIONAL TUNING ACCEPTANCE TESTING

What is "Institutional Tuning"?

Lacking a formal definition, NA7.7.6.2.1 (a) states: "… methods of controlling the maximum output of luminaires is such that the maximum light output of the controlled lighting system can be limited and that normal operation of the controlled lighting does not override the maximum light output."

In other words; by some fashion the controlled lighting in an area has been "capped" or limited on the "top end" to insure the controlled lighting does not exceed 85% of fully installed output illumination, ("Full output"). In this scheme no Area Control, Multi-Level Control, or Automatic Daylighting Control may drive the lights to "Full output", ("Fully Installed Lighting Power").

What's the problem?

Institutional Tuning can be accomplished through a wide variety of methods: from simple to incredibly complex. A requirement to verify this Institutional Tuning assumes that an Acceptance Test Technician will be supplied with a wealth of information required for the test. This PAF verification also assumes that a Certificate of Installation has been previously completed and is correct and complete. Anecdotal evidence suggests that quite often the Field Technician is currently completing Certificates of Installation for electrical contractors who have hired them. Currently "… the person in charge of construction or installation …" and the "enforcement agency" personnel may often be unfamiliar with the new Certificate of Installation requirements. An Acceptance Test Technician should feel secure that an installation is functioning properly, as they have just tested it for compliance. However: missing PAF Installation forms; NRCI-LTI-05-E; will not be readily apparent to the Field Technician. This is because neither of the Compliance Certificates currently attached to the building plans, NRCC-LTI-01-E and NRCC-LTI-02-E, contain specific PAF worksheets. Therefor the Institutional Tuning PAF test should be an *Installation Test*.

How can Institutional Tuning be accomplished?

Wow … by any of a variety of manners … to name a few: Automatic Lumen Maintenance using a closed-loop photosensor; Setting a limit on the control output, either analog or digital, of a "room controller"; Inserting resistors in 0-10V control lines; Programming *individual* digital ballasts in an area for a maximum output; Adjusting limits in an Automatic Daylighting controller; Programming a PLC or SCADA system in an EMCS or Lighting Control System; or, Adjusting settings in a Multi-Level Control.

There are probably more. Familiarity with all the different controls and programming schemes for a particular Institutional Tuning "control" should be the realm of the lighting commissioning agent, not necessarily an Acceptance Test technician.

How can Institutional Tuning Acceptance Testing be accomplished?

The Field Technician needs to be informed that Institutional Tuning exists at the site in question. The Field Technician must know how it was accomplished. The Field Technician then needs to figure out how to defeat these settings, and how to restore them. In the case of Automatic Lumen Maintenance the Field Technician *should* be able to simply cover the closed-loop photosensor, but he must have documentation that allows him to know that this *is* a valid test. Any other sort of system but this becomes problematic – causing the Field Technician to break and make control lines, or reprogram previously commissioned lighting controls. This may become quite time-consuming and could lead to equipment damage or deprogramming.

An example:

An area has a nPODM4PDX Wallpod installed as a 4-zone "smart-switch". It uses one channel each for 1) Primary Sidelit Control, 2) Secondary Sidelit Control, 3) Other General Lighting Control, and 4) "Wall-washers". The control suite sports a nCM ADCX Single-zone photocell sensor and Secondary Sidelit adjustment is made at one of four nSP5 PCD 3W dimming modules installed.

Assuming the Field Technician knows that Institutional Tuning is in play, the Field Technician must do the following:

1) Cover the closed-loop photocell sensor,
2) Gain access to each nSP5 PCD 3W dimming module,
3) Activate just the Controlled Lighting associated with the dimming module under test,
4) Position a light meter appropriately and insure manual dimming control is up full,
5) Take a light meter reading,
6) Hold the dimming modules button down until its LED indicator flashes rapidly,
7) Press that button twenty-three times,
8) Count the LED flashes to insure less than ten flashes,
9) If less than ten flashes, note the number,
10) Press the button 10 times,
11) Insure the LED indicator flashes back ten times,
12) Hold down the button until the LED indicator flashes rapidly,
13) Then, press the button twenty-three times, *again*,
14) Watch for the LED to blink back twice,
15) Insure manual dimming control is up full,
16) Take another light meter reading,
17) Hold the dimming modules button down until its LED indicator flashes rapidly,
18) Press that button twenty-three times,
19) Insure the LED indicator flashes back ten times,

20) Press the button the number of times noted in step 9),
21) Insure the LED indicator flashes back the number of times noted in step 9),
22) Hold down the button until the LED indicator flashes rapidly,
23) Then, press the button twenty-three times, *again*,
24) Watch for the LED to blink back twice,
25) Insure manual dimming control is up full,
26) Take another light meter reading and insure it matches the reading from step 5)

Now repeat this for at least two more, possibly all, of the dimmer modules: or maybe, more than the four stated, as the dimming modules will have a maximum rating that must be observed, (there might be many more modules installed.) If the required number of flashes are not observed anywhere along the way, start over.

Believe it or not – this was an *easy* one – assuming you know how to do this in the first place. Now, multiply this by the number of similar systems currently in the field and it can be seen that this testing can be *extremely* time consuming. Most of the time consumed will probably be spent searching for the proper information to conduct the testing. Suppose Institutional Tuning is accomplished with a large panel system utilizing a micro-controller with LCD screen and keypad: The Acceptance Test Technician will have to work through levels of programming to make the test; and may require a keypad lock-out code. The same concerns are present for an EMCS operating as a Lighting Control System. Additionally, any program modifications here involve a system that may also control HVAC and *building security*.

The author of this document feels this places an undue monetary burden on the contractor or building owner involved, as they must now have portions of the Lighting Control System "commissioned" *twice.*

Please note: This is just testing of a *PAF*. Energy savings might not be insured.

Obviously, the person best suited to safely manipulate the lighting controls is the person who commissions them in the first place during installation. So, this should be an Installation Test.

Other than the arguments above, the test specifications reside in NA7.7, along with other install specifications. NA7.6 and NA7.8 contain the specifications for Acceptance Testing indoor and outdoor respectively: and these are all *mandatory controls that must be installed*. It is the authors' opinion that Acceptance Testing should be confined to those types of controls – (despite the current testing requirement of the PAF detailed in 140.6 (a) 2. I.)

Liability

Due to the unknown, but possibly *very* high costs of requiring Acceptance Testing of Institutional Tuning, it seems some sort of cost analysis should have been done. But the author cannot see that it could have been. This is a voluntary PAF for use by lighting designers. This is *not* necessarily an energy saving ploy. Add to this the possibility of damaged equipment or lost programming and it would seem risky for the California Energy Commission to require such a thing. This should be an Installation Test only.

ARGUMENTS AGAINST THE INSTITUTIONAL TUNING PAF IN GENERAL

While it is nice to arm lighting designers with another tool – I cannot see that this will be a popular one. In addition to the possible added expense for equipment, and definite increased commissioning costs, little is to be gained from this PAF unless a designer wishes to correct for a poor design. Note, the Institutional Tuning PAF *is not* an Automatic Lumen Maintenance PAF, although it could be done that way. The requirement is merely a hard "cap" of the illuminance top end – a good guess is that this may lead to more frequent relamping. Also, if this is a part of a scheme to force building owners to tune lighting by making this a mandatory requirement in the future: why not just lower the allowed lighting power density allotments and be done with it?

Please consider making this an Automatic Lumen Maintenance PAF. This might prove beneficial and would easily lend itself to Acceptance Testing. Any field technician can test this one – and there are energy savings as well.

SUGGESTED CODE LANGUAGE CHANGES

1)

NA7.7.6.2 Acceptance Tests for Institutional Tuning

For buildings with up to seven (7) enclosed areas claiming the Institutional Tuning PAF (power adjustment factor), all areas shall be tested. For buildings with more than seven (7) areas claiming this PAF, random sampling may be done on seven of the larger enclosed areas with tuned dimming systems. If any of the areas in the sample group of seven areas fails the acceptance test, another group of seven areas must be tested. If any tested system fails, it shall be tuned until it passes the test.

Changed to:

NA7.7.6.2 <u>Installation Inspection</u> for Institutional Tuning

For buildings with up to seven (7) enclosed areas claiming the Institutional Tuning PAF (power adjustment factor), all areas shall be tested. For buildings with more than seven (7) areas claiming this PAF, random sampling may be done on seven of the larger enclosed areas with tuned dimming systems. If any of the areas in the sample group of seven areas fails the <u>installation inspection</u>, another group of seven areas must be tested <u>– should they exist</u>. If any tested system fails, it shall be tuned until it passes the test.

2)

NA7.7.6.2.2 Functional testing of Institutional Tuning

For each area to be tested, do the following:

(a) The acceptance test technician shall either observe the first seven (7) systems being successfully tuned or shall verify systems that have already been tuned using the sampling protocol described in NA7.7.6.2.

(b) If the acceptance test technician is observing the tuning of the system, the party responsible for the tuning shall certify that the remainder of the system is tuned in a similar manner.

Changed to:

NA7.7.6.2.2 Functional testing of Institutional Tuning

For each area to be tested, do the following:

(a) The person in charge of construction or installation shall either observe the first seven (7) systems being successfully tuned or shall verify systems that have already been tuned using the sampling protocol described in NA7.7.6.2.

(b) If the person in charge of construction or installation is observing the tuning of the system, the party responsible for the tuning shall certify that the remainder of the system is tuned in a similar manner.

3) (A spelling correction)

Observation of the systems during Institutional Tuning

Step 1: Determination of maximum power or output prior to Institutional Tuning

(a) Set all lighting controls to provide maximum output of the tested system without applying the limits specified for institutional tuning.

(b) Measure the full light output at a location where the illuminance is due to the controlled lighting, or measure the power draw of the controlled lighting.

Step 2: Institutional Tuning and Post-tuning Measurement

(a) Apply the limits specified for instutional tuning to the lighting system. Do not alter any other control settings.

(b) Verify the light or power reduction after institutional tuning by measuring the light output at the same location as in Step 1 or measure the power draw of the same circuit as in Step 1.

(c) If the light output or power draw measured in Step 2(b) is 85% or less of the light output or power draw measured in Step 1(b), the system passes this test; otherwise the system fails this test.

Changed to:

Observation of the systems during Institutional Tuning

Step 1: Determination of maximum power or output prior to Institutional Tuning

(a) Set all lighting controls to provide maximum output of the tested system without applying the limits specified for institutional tuning.

(b) Measure the full light output at a location where the illuminance is due to the controlled lighting, or measure the power draw of the controlled lighting.

Step 2: Institutional Tuning and Post-tuning Measurement

(a) Apply the limits specified for institutional tuning to the lighting system. Do not alter any other control settings.

(b) Verify the light or power reduction after institutional tuning by measuring the light output at the same location as in Step 1 or measure the power draw of the same circuit as in Step 1.

(c) If the light output or power draw measured in Step 2(b) is 85% or less of the light output or power draw measured in Step 1(b), the system passes this test; otherwise the system fails this test.

4)

Section: **Verification of systems already tuned** can be retained.

5)

In the 15-day 2016 Building Energy Efficiency Standards ***SECTION 130.4 (a)***:

7. Certifies that lighting systems receiving the Institutional Tuning Power Adjustment Factor, comply with Section 140.6(a)2J and Reference Nonresidential Appendix NA7.7.6.2.

Should be changed to:

7. Certifies that lighting systems receiving the occupant sensing control controlling the general lighting in large open plan office areas above workstations Power Adjustment Factor, comply with Section 140.6(a)2I and Reference Nonresidential Appendix NA7.7.6.1.

PLEASE NOTE: The PAF for "occupant sensing control controlling the general lighting in large open plan office areas above workstations" ***is Already Required to Undergo Acceptance Testing per FORM: CEC–NRCA-LTI-02-A, Part B, Block 05.***

This form excerpt is shown on the next page:

05. Additional test for Occupancy Sensors Serving Small Zones in Office Spaces Larger than 250 Square Feet, to Qualify for a Power Adjustment Factor (PAF)		1	2	3
First, complete Functional Test 2 (above) for each controlled zone				
Step 1. Verify area served and compare actual PAF with claimed PAF. Refer to Functional Test II.				
a.	Area served by controlled lighting (square feet)			
b.	Enter PAF corresponding to controlled area from line (a) above (<125sf for PAF=0.4, 126-250sf for PAF=0.3, 251-500sf for PAF=0.2).			
c.	Enter PAF claimed for occupant sensor control in this space from the Certificate of Compliance			
d.	The PAF corresponding to the controlled area (line b), is less than or equal to the PAF claimed in the compliance documentation (line c)	Y / N	Y / N	Y / N
e.	Sensors shall not trigger in response to movement in adjacent walkways or workspaces.	Y / N	Y / N	Y / N
f.	All steps are conducted in Functional Test 2 "Occupancy Sensor (On Off Control)" and all answers are Yes (Y)	Y / N	Y / N	Y / N

Figure 1. Acceptance Testing Form: NRCA-LTI-02-A

6)

In the 15-day 2016 Building Energy Efficiency Standards SECTION 140.6 (a) 2. J.

J. To qualify for the PAF for an Institutional Tuning in TABLE 140.6-A, the tuned lighting system shall comply with all of the following requirements:

i. The lighting controls shall limit the maximum output or maximum power draw of the controlled lighting to 85% percent or less of full light output or full power draw; and

ii. The means of setting the limit is accessible only to authorized personnel; and

iii. The setting of the limit is verified by the acceptance test required by Section 130.4(a)7; and

iv. The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85% of full light outpur or full power draw.

Changed to:

J. To qualify for the PAF for an Institutional Tuning in TABLE 140.6-A, the tuned lighting system shall comply with all of the following requirements:

i. The lighting controls shall limit the maximum output or maximum power draw of the controlled lighting to 85% percent or less of full light output or full power draw; and

ii. The means of setting the limit is accessible only to authorized personnel; and

iii. The setting of the limit is verified by the installation test required by Section 130.4(b); and

iv. The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85% of full light output or full power draw.

CONCLUSION

The verification of the Institutional Tuning PAF should be an *Installation Test* documented on Certificate of Installation: NRCI-LTI-05-E, by the person responsible for construction or installation of the lighting control system or components, (or their *Authorized Representative* per Section 10-103 (a) 3. ii).

An Acceptance Test Technician should not be encouraged to modify lighting control programming. Nor should a Field Technician be forced to open control wiring on lighting control outputs, or make adjustments to lighting control system limits or setpoints. A Field Technician should strive to achieve honest, repeatable and verifiable testing procedures – "standardized", if you will. Only compliance paperwork is legally required to be presented to the Field Technician, not additional design documentation or programming notes. Field Technicians should feel competent to come in as third-party testers and not have to be privy to information that is not legally required to be supplied to them. There is also no obligation on anyone's part to supply test cables or interface devices or programs or passwords to a Field technician.

The California Energy Commission should consider that they may be held liable, (at least in part), for any chaos caused by Institutional Tuning Acceptance Testing if they are dictating this requirement.

Thank you for considering my remarks,

Robert Shearer, BSEE